

Amendments to the Claims

The following listing of claims replaces all prior versions, and listings, of claims in the application:

Claims 1-97 (Cancelled).

98. (New) Method for the contactless detection of flat objects, such as papers in sheet form with respect to a single sheet, a missing sheet and multiple sheets of said flat objects,

said flat objects being placed in a beam path of at least one transmitter and an associated receiver of a sensor device,

wherein a radiation transmitted between said at least one transmitter and said receiver is received by said receiver in the form of a measuring signal (U_M),

said measuring signal (U_M) is supplied to a following evaluation for generating a corresponding detection signal,

wherein a characteristic of an input voltage (U_E , U_M) of said measuring signal (U_M) is formed, and

wherein at least one correction characteristic (KK) is provided for evaluation,

said correction characteristic (KK) transforms said characteristic of the input voltage (U_E , U_M) of said measuring signal (U_M) from said receiver (R) as a function of a weight per unit area of said flat objects (2) to a target characteristic (ZK),

that for said papers in sheet form an approximately linear characteristic approaching an ideal single sheet characteristic with a gradient of approximately "0" is obtained as said target characteristic between an output voltage (U_A , U_Z) at an output of the evaluation and said weight per unit area, in order to generate said corresponding detection signal.

99. (New) Method according to claim 98, wherein said correction characteristic (KK) for papers and similar materials is derived from a characteristic of said input voltage (UE, UM) of said measuring signal mirrored on an ideal or approximated target characteristic (ZK) for single sheet detection.

100. (New) Method according to claim 98, wherein the correction characteristics for papers is derived from a target characteristic approximated to the ideal target characteristic of the single sheet detection following Cartesian coordinate transformation with respect to a line linking two end points of the characteristic of said measuring signal for a material spectrum of said weight per unit area to be detected mirroring the characteristic of the input voltage (UE, UM) of the measuring signal.

101. (New) Method according to claim 98, wherein by means of said correction characteristic said characteristic of the input voltage (UE, UM) of the measuring signal is transformed into said target characteristic over a wide weight per unit area range between about 8 and 4000 g/m².

102. (New) Method for the contactless detection of flat objects, such as multilaminated materials like labels adhesively applied to support material, with respect to the presence or absence of said flat objects, said flat objects being placed in a beam path between a transmitter and an associated receiver of a sensor device, wherein a radiation transmitted through the flat objects or the radiation received in the case of an absence of said flat objects by said receiver, is received as measuring signal (U_M) said measuring signal (U_M) is supplied to a following evaluation for generating a corresponding detection signal, wherein a characteristic of an input voltage (U_E , U_M) of said measuring signal (U_M) is formed, and wherein at least one correction characteristic (KK) is supplied to said evaluation, said correction characteristic (KK) transforms the characteristic of the input voltage (U_E , U_M) of said measuring signal (U_M) from said receiver (R) as a function of a weight per unit area of said flat objects (2) to a target characteristic (ZK), that for said multilaminated materials an almost linear characteristic with a maximum finite gradient in said weight per unit area range to be detected is obtained as said target characteristic approximated to said ideal target characteristic between an output voltage (U_A , U_Z) at the output of the evaluation and said weight per unit area, for generating said corresponding detection signal.

103. (New) Method according to claim 102, wherein said correction characteristic (KK) for multilaminated materials like labels is derived from the characteristic of said input voltage (UE, UM) of said measuring signal, which is mirrored on an ideal detection characteristic (ZK) for multilaminated materials in the weight per unit area range to be detected.

104. (New) Method according to claim 102, wherein said correction characteristic (KK) for multilaminated materials like labels is derived from the characteristic of said input voltage (UE, UM) of said measuring signal, which is mirrored on an ideal detection characteristic (ZK) for multilaminated materials in weight per unit area range to be detected following Cartesian coordinate transformation relative to a connecting line of two end points of the measuring signal characteristic for a material spectrum of said weight per unit area range to be detected.

105. (New) Method according to claim 102, wherein in the case of multilaminated materials like labels, by means of said correction characteristic (KK) the characteristic of said input voltage (UE, UM) of said measuring signal is transformed to said target characteristic (ZK) over the weight per unit area range to be detected, between approximately 40 to 300 g/m².

106. (New) Method according to claim 102, wherein said correction characteristic (KK) is chosen in such a way that said target characteristic (ZK) is obtained with a maximum

finite, constant negative gradient and maximum voltage difference over the weight per unit area range to be detected, between approximately 40 to 300 g/m².

107. (New) Method according to claim 102, wherein the evaluation, particularly the measuring signal amplitude, is performed at least over one signal amplification, that said signal amplification is supplied with at least one correction characteristic in such a way that at the signal amplification output said target characteristic for generating the detection signal is obtained.

108. (New) Method according to claim 98, wherein the evaluation, particularly the measuring signal amplitude is performed at least over one signal amplification, that said signal amplification is supplied with at least one correction characteristic in such a way that at the signal amplification output said target characteristic for generating the detection signal is obtained.

109. (New) Method according to claim 108, wherein analog signals of an analog-digital conversion received in the receiver with subsequent or direct digital rating are subject to at least one correction characteristic for generating said corresponding detection signal.

110. (New) Method according to claim 98, wherein as flat objects also cardboard in sheet form, corrugated board or stackable packages are placed in the beam path between transmitter and receiver.

111. (New) Method according to claim 98, wherein said correction characteristic is impressed as a single characteristic over the entire weight per unit area range.

112. (New) Method according to claim 98, wherein said correction characteristic is impressed as a zonal combination of several different correction characteristics .

113. (New) Method according to claim 98, wherein said correction characteristic is impressed as a continuous correction characteristic over portions of the entire weight per unit area range.

114. (New) Method according to claim 98, wherein said correction characteristic is fixed impressed.

115. (New) Method according to claim 98, wherein said correction characteristic is actively controlled.

116. (New) Method according to claim 98, wherein with respect to the single, missing or multiple sheet, at least two thresholds are given as the upper and lower threshold and in the case of the incoming measuring signal being larger than the upper threshold, it is evaluated as a "missing sheet", when the incoming measuring signal is between the thresholds this is evaluated as a "single sheet" and when the incoming measuring signal is smaller than the lower threshold, this is evaluated as a "multiple sheet".

117. (New) Method according to claim 102, wherein relative to flat objects like labels, splices and break points and tear-off threads there is at least one detection threshold, on passing below said detection threshold this is evaluated as a "multiple layer" and on exceeding the detection threshold it is evaluated as a "support material or a multiple layer reduced by at least one layer".

118. (New) Method according to claim 116, wherein the thresholds are designed so as to be dynamically carried along.

119. (New) Method according to claim 117, wherein said at least one detection threshold is designed so as to be dynamically carried along.

120. (New) Method according to claim 98, wherein said correction characteristic is determined as a function of the object and material-specific transmission attenuation and the resulting measuring signal voltage depending on the weight per unit area, and wherein from this determination takes place of the optimum correction characteristic.

121. (New) Method according to claim 98, wherein said correction characteristic for several areas of material spectra is subdivided into several sections.

122. (New) Method according to claim 121, wherein at least three sections are provided and associated with different weight per unit area ranges.

123. (New) Method according to claim 98, wherein at least one sensor out of a group of ultrasonic sensor, optical sensor, capacitive sensor, inductive sensor is used as said sensor device.

124. (New) Method according to claim 102, wherein at least one sensor out of a group of ultrasonic sensor, optical sensor, capacitive sensor, inductive sensor is used as said sensor device.

125. (New) Method according to claim 98, wherein as said sensor device use is made of at least one ultrasonic sensor and at least one sensor out of the group of optical, capacitive, inductive sensors.

126. (New) Method according to claim 123, wherein at least one ultrasonic sensor is operated in pulsed form.

127. (New) Method according to claim 126, wherein a teach-in process for the material to be detected is performed with the ultrasonic sensor operated in pulsed form.

128. (New) Method according to claim 98, wherein on the evaluation of the measuring signals of different types of sensors are impressed different correction characteristics for obtaining at least one target characteristic for each individual sensor for the detection of single, missing and multiple sheets of flat objects such as papers.

129. (New) Method according to claim 103, wherein on the evaluation of the measuring signals of different types of sensors are impressed different correction characteristics for obtaining at least one target characteristic for the detection of flat objects, such as multilaminated materials.

130. (New) Method according to claim 98, wherein an analog-digital conversion is performed on the measuring signal of said receiver.

131. (New) Method according to claim 130, wherein the detection of single, missing and multiple sheets takes place by logical interconnection like AND-OR interconnection, by means of a selection of signals after evaluation by means of a target characteristic.

132. (New) Method according to claim 98, wherein the detection signal for single sheet, missing sheet, multiple sheets and stacked packaging materials is determined in continuous conveying operation of said flat objects.

133. (New) Method according to claim 98, wherein the detection signal for single sheet, missing sheet, multiple sheets and stacked packaging materials is determined during a teach-in process of at least one sensor of said sensor device and is taken into account for detection in continuous conveying operation as a threshold value.

134. (New) Method according to claim 98, wherein said transmitter (T) and receiver (R) of said sensor device (10) are oriented with respect to one another in a main beam axis

of the radiation used and wherein the main beam axis is oriented substantially perpendicular to the plane of said flat objects moved at least relative between the transmitter (T) and the receiver (R).

135. (New) Method according to claim 98, wherein said transmitter (T) and receiver (R) of said sensor device (10) are oriented with respect to one another in a main beam axis of the radiation used and wherein the main beam axis is oriented under an angle to the plane of said flat objects moved at least relative between the transmitter (T) and the receiver (R).

136. (New) Method according to claim 102, wherein said transmitter (T) and receiver (R) of said sensor device (10) are oriented with respect to one another in a main beam axis of the radiation used and wherein the main beam axis is oriented substantially perpendicular to the plane of said flat objects moved at least relative between the transmitter (T) and the receiver (R).

137. (New) Method according to claim 102, wherein said transmitter (T) and receiver (R) of said sensor device (10) are oriented with respect to one another in a main beam axis of the radiation used and wherein the main beam axis is oriented under an angle to the plane of said flat objects moved at least relative between the transmitter (T) and the receiver (R).

138. (New) Method according to claim 123, wherein in continuous operation of said sensor device (10) short interruptions of the transmitting signal are provided to prevent standing waves and interferences.

139. (New) Method according to claim 98, wherein the transmitting signal of transmitter (T) is frequency-modulated.

140. (New) Method according to claim 98, wherein for ultrasonics, transmitter (T) and receiver (R) are standardized pairwise to an optimum assembly spacing and wherein tolerances of the transmitter and receiver are automatically corrected at the start and during continuous operation.

141. (New) Method according to claim 98, wherein the spacing between the transmitter and receiver is determined by reflection of the radiation used between transmitter and receiver when attenuating sheet material is positioned between them, and that on rising above or dropping below the permitted spacings a fault announcement is provided.

142. (New) Method according to claim 134, wherein for the detection of single-corrugation or multiple-corrugation corrugated board and the conveying direction thereof, the sensor axis between the transmitter and receiver of at least one sensor is placed so as to be inclined to the perpendicular of the corrugated board sheet and in particular orthogonally to the widest surface of the corrugated board corrugation.

143. (New) Method according to claim 98, wherein a feedback for maximizing the amplitude of said measuring signal received is performed between said evaluating device and said transmitter.

144. (New) Method according to claim 109, wherein for digitizing the analog measuring signal use is made of at least one A/D converter and for selecting the different signals of the signal amplifying devices use is made of a time multiplex method.

145. (New) Device for the contactless detection of flat objects,
 with first flat objects such as papers in sheet form, with respect to a single sheet, a missing sheet and multiple sheets of said first flat objects, and
 second flat objects such as multilaminated materials like labels adhesively applied to support materials, with respect to the presence or absence of said second flat objects,
 said device having at least one sensor device (10) with at least one transmitter (T) and an associated receiver (R),
 said first and second flat objects being placed in a beam path between said transmitter (T) and said receiver (R) for detection,
 said receiver (R) receiving a measuring signal by a radiation transmitted between said at least one transmitter (T) and said associated receiver (R),
 with means for forming a characteristic of an input voltage (U_E , U_M) of said measuring signal (U_M), and with a downstream evaluating device (4) to which said measuring signal (U_M , U_E) is supplied for generating a corresponding detection signal, wherein
 said evaluating device (4) has several specific channels for the detection of said first flat objects such as papers and said second flat objects such as multilaminated materials,
 said specific channels having impressed different correction characteristics for the characteristic of the input voltage (U_E , U_M) of said measuring signal (U_M) for papers and for multilaminated materials,
 said correction characteristics (KK) transform said characteristics of the input voltage (U_E , U_M) of said measuring signal from said receiver (R) as a function of the weight per unit area of the flat objects so as to give a corresponding target characteristic (ZK),

that it is possible for the first flat objects such as papers to produce an approximately linear characteristic approaching an ideal single sheet characteristic with a gradient of approximately "0" in the form of said corresponding target characteristic (ZK) between an output voltage (U_A , U_Z) at an output of said evaluating device and the weight per unit area, in order to generate said corresponding detection signal, for said first flat objects,

and

that it is possible for the second flat objects such as multilaminated materials to produce an almost linear characteristic having a maximum finite gradient in said weight per unit area range to be detected, as a target characteristic approximating said ideal target characteristic between an output voltage (U_A , Z_U) at the output of said evaluation device and said weight per unit area, in order to generate said corresponding detection signal for said second flat objects.

146. (New) Device according to claim 145, wherein the evaluating device (4) has a correction characteristic (KK) for said first flat objects with a characteristic of said input voltage (U_E , U_M) of the measuring signal mirroring the ideal or thereto approximated target characteristic (ZK) for the purpose of single sheet detection.

147. (New) Device according to claim 145, wherein said correction characteristic for first flat objects is chosen in such a way that the characteristic of said input voltage (U_E , U_M) of the measuring signal is transformable into the target characteristic over a weight per unit area range between about 8 and 4000 g/m².

148. (New) Device according to claim 145, wherein said correction characteristic (KK) for the second flat objects can be produced by mirroring the characteristic of said input voltage (UE, UM) of the measuring signal on the ideal detection target characteristic (ZK) for the second flat objects in the gram weight or weight per unit area range to be detected.

149. (New) Device according to claim 145, wherein said correction characteristic for the second flat objects is chosen in such a way that the characteristic of the measuring signal input voltage (UE, UM) is transformable to the target characteristic over a gram weight or weight per unit area range of approximately 40 to 300 g/m².

150. (New) Device according to claim 145, wherein said target characteristic (ZK) for the second flat objects has a maximum finite, constant negative gradient and a maximum voltage difference relative to changes in the weight per unit area range between about 40 to 300 g/m².

151. (New) Device according to claim 145, wherein said evaluating device (4) has at least one amplifying device (5) and wherein the amplifying device (5) is supplied with at least one correction characteristic (KK) for producing said target characteristic (ZK) at the output of said amplifying device.

152. (New) Device according to claim 145, wherein said evaluating device (4) has an analog-digital converter means for converting said measuring signal from said receiver

and wherein an evaluating device (6) for the subsequent digital evaluation of said converted measuring signal by means of a correction characteristic (KK) is provided for generating a detection signal.

153. (New) Device according to claim 145, wherein said correction characteristic is built up as a zonal combination of several different correction characteristics over the entire weight per unit area range.

154. (New) Device according to claim 145, wherein said correction characteristic for first flat objects is provided as almost inverse characteristic to said characteristic of the measuring signal input voltage (UE, UM).

155. (New) Device according to claim 145, wherein said correction characteristic (KK, 23) is fixed impressed.

156. (New) Device according to claim 145, wherein said correction characteristic (KK, 23) is given in material specific manner.

157. (New) Device according to claim 145, wherein said correction characteristic (KK, 23) is regulated dynamically.

158. (New) Device according to claim 145, wherein with respect to the single, missing and multiple sheet for the first flat objects, said evaluating device (4) is provided with at least two thresholds in the form of an upper and lower threshold and when the incoming

measuring signal is greater than the upper threshold, this is detected as a "missing sheet", when the incoming measuring signal is between the thresholds this is detected as a "single sheet" and when the incoming measuring signal is smaller than the lower threshold, this is detected as a "multiple sheet".

159. (New) Device according to claim 145, wherein said evaluating device (4) is supplied with at least one detection threshold with respect to said second flat objects, in which dropping below the detection threshold is evaluated as "multiple layer" and exceeding said detection threshold is evaluated as "support material or a multiple layer reduced by at least one layer".

160. (New) Device according to claim 158, wherein the thresholds are designed so as to be set in fixed manner.

161. (New) Device according to claim 158, wherein the thresholds are designed so as to be dynamically carried along.

162. (New) Device according to claim 145, wherein said second flat objects are passed between said transmitter and receiver and as a function of the specific object measuring signal received the object-specific switching threshold can be determined in automatic triggered manner relative to the target characteristic.

163. (New) Device according to claim 145, wherein said sensor device (10) has at least one ultrasonic sensor and at least one sensor out of the group of optical, capacitive or inductive sensors in combination.

164. (New) Device according to claim 163, wherein there are several sensors (9, 44) over a width of a sheet (2, 3).

165. (New) Device according to claim 163, wherein there is a sensor (9) roughly centrally with respect to a sheet (3) and two sensors (9, 9) in a marginal area of said sheet.

166. (New) Device according to claim 163, wherein, considered in the conveying direction (F) of sheets (3), upstream of said sensor device (10) at least one further sensor (44) is provided.

167. (New) Device according to claim 163, wherein, considered in the conveying direction (F) of sheets (3), downstream of said sensor device (10) at least one further sensor (44) is provided.

168. (New) Device according to claim 163, wherein the measuring signals of said sensors (R, 9, 44) are supplied to at least one evaluating device (4) on which is impressed at least one correction characteristic (KK).

169. (New) Device according to claim 163, wherein the measuring signals of different sensor types (9, 44) are supplied to different evaluating devices via separate channels.

170. (New) Device according to claim 163, wherein the output signals of different sensor types (9, 44) are supplied via separate channels to the evaluating device (4).

171. (New) Device according to claim 145, wherein an analog-digital conversion takes place with respect to said measuring signal and wherein the digitized measuring signals of the individual sensors are supplied to a logical interconnection for detection of single sheet, a missing sheet and multiple sheets of said first flat objects.

172. (New) Device according to claim 145 wherein there is at least one sensor device (10) for detecting a single sheet, a missing sheet and multiple sheets with respect to said first flat objects and at least one further sensor device (45) for detecting said second flat objects such as multilaminated materials like labels.

173. (New) Device according to claim 145, wherein for the detection of first flat objects in the form of metal sheets there is at least one ultrasonic sensor device (10) combined with at least one inductive sensor device (45).

174. (New) Device according to claim 145, wherein for the detection of first flat objects in the form of metal sheets there is at least one ultrasonic sensor device (10) combined with at least one inductive sensor device (45) and a mechanical sensor device.

175. (New) Device according to claim 145, wherein said transmitter (T) and receiver (R) of a sensor device are placed in forked manner in facing oriented form.

176. (New) Device according to claim 145, wherein said transmitter (T) and said receiver (R) of a sensor device have no casing and are provided on a printed circuit board.

177. (New) Device according to claim 145, wherein at least two combined sensors (9, 44) are provided for detecting single, missing and multiple sheets of said first flat objects in the form of corrugated board sheets.

178. (New) Device according to claim 177, wherein at least two combined ultrasonic sensors (9, 44) are provided for detecting single, missing and multiple corrugated board sheets, that at least one of said ultrasonic sensors is provided according to a transmission principle and a method of using a correction characteristic and that at least one further ultrasonic sensor is designed in pulsed form.

179. (New) Device according to claim 178, wherein the ultrasonic sensor operated according to the method of using a correction characteristic is installed at an angle β_1 to a sheet normal of said corrugated board sheet and that the pulsed ultrasonic sensor is designed in transit time and temperature-compensated manner.

180. (New) Device according to claim 178, wherein said pulsed ultrasonic sensor is set by a teach-in process.

181. (New) Device according to claim 177, wherein at least two combined ultrasonic sensors according to the method of using a correction characteristic are provided for detecting the layer and conveying direction of single corrugated board sheets and wherein said ultrasonic sensors are arranged orthogonally to one another and installed at an angle β_1 to the corrugated board sheet normal.

182. (New) Device according to claim 145, wherein said transmitter (T) and receiver (R) of the sensor device are mutually oriented, in the main beam axis of the radiation used and wherein the main beam axis is oriented substantially perpendicular to the plane of the flat objects (2) arranged between transmitter (T) and receiver (R).

183. (New) Device according to claim 145, wherein said transmitter (T) and receiver (R) of the sensor device are mutually oriented in the main beam axis of the radiation used and wherein the main beam axis is oriented under an angle to the plane of the flat objects (2) arranged between transmitter (T) and receiver (R).

184. (New) Device according to claim 145, wherein said evaluating device (4) has several parallel-connected amplifying devices (21, 22), whose output signals are combined for said target characteristic (23).

185. (New) Device according to claim 145, wherein said sensor device (10) has an operating mode which can be transformed from pulsed operation to continuous operation and vice versa.

186. (New) Device according to claim 145, wherein in continuous operation the transmitting signal has phase jumps.

187. (New) Device according to claim 145, wherein in continuous operation the transmitting signal has short interruptions

188. (New) Device according to claim 145, wherein said transmitting signal is frequency-modulated.

189. (New) Device according to claim 145, wherein a device for setting the transmitting frequency and/or transmitting amplitude with respect to the receiver signal is provided.

190. (New) Device according to claim 145, wherein auto-balancing means are provided and auto-balancing can be performed in times synchronized with the transmitting frequency or in defined pause periods.

191. (New) Device according to claim 145, wherein said transmitter (T) and receiver (R) have sensor heads and the spacing between said sensor heads, can be varied as a function of the application.

192. (New) Device according to claim 145, wherein there is a feedback device between said evaluating device (4) and said sensor device (10).

193. (New) Device according to claim 145, wherein said evaluating device (4) has several specific channels for the detection of said first flat objects and said second flat objects, that different correction characteristics are impressed on the channels and that there are multiplexers (34, 35) for controlling the inputs and outputs of said channels for producing an overall target characteristic.

194. (New) Device according to claim 145, wherein said transmitter is provided below the flat objects to be detected and said receiver above the same and that the transmitter head has a limited spacing from the flat object.

195. (New) Device according to claim 145, wherein between the transmitter (T) and said flat objects (2) to be detected there is at least one pinhole diaphragm for improving the spatial resolution in the case of sensors out of the group of ultrasonic and optical sensors.

196. (New) Device according to claim 145, wherein between the transmitter (T) and said flat objects (2) to be detected there is at least one lens for improving the spatial resolution in the case of sensors out of the group of ultrasonic and optical sensors.

197. (New) Device according to claim 195, wherein the arrangement of the diaphragms takes place transversely to the movement direction of said flat objects.

198. (New) Device according to claim 195, wherein the arrangement of the diaphragm takes place longitudinally to the movement direction of the second flat objects.

199. (New) Device according to claim 195, wherein slit diaphragms are positioned in a thread running direction for detecting elongated second flat objects adhesively applied to the base material.

200. (New) Device according to claim 195, wherein said flat objects (2) introduced between transmitter (T), receiver (R) and the diaphragm float as close as possible over the diaphragm.